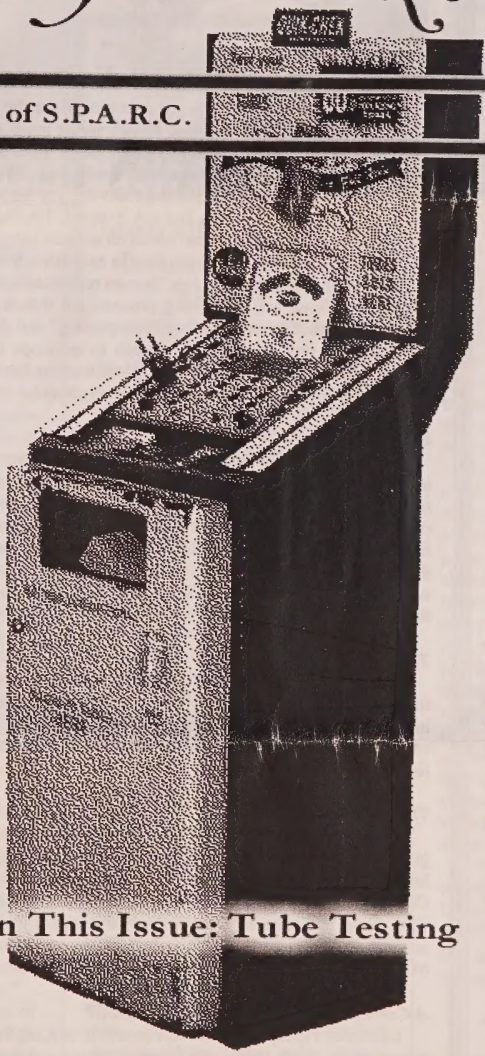
Syntonizer

Newsletter of S.P.A.R.C. October, 2001



In This Issue: Tube Testing

S.P.A.R.C.
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Sytonizer

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The Society exists for the purpose of preserving for future generations the electrical and radio-electronic communications artefacts that defined the 20th Century and to pass on the now rapidly diminishing expertise in their maintenance. Membership is open to all those interested in furthering those aims.

The Society operates a museum located on the campus of Riverview Hospital, Coquitlam, B.C. Call 604-777-1885 for up to date information on opening hours. Children are especially welcome. Special openings and extra display interpreters can be provided for large groups by prearrangement.

Tour and technical enquiries may be directed to the President. Enquiries regarding tax exempt financial donations and bequests should be directed to the Society's solicitors, Russell and Company, Suite 220, 4411 East Hastings Street, Vancouver, B.C., V5C 2K1.

Editorial Comment

As those readers of these pages who have done the job will know, a member of an organization tapped to manage its newsletter must, metaphorically, stand before a mirror, face his image squarely, draw himself up to full height then lean forward slowly and fix himself in the eye with steely gaze. "Fellah, the buck ends on your desk." he says to himself. "If you take this on, you have to be prepared to do *everything* and deliver newsletters and not excuses. From finding material all the way through to stamp licking you can count on nobody but *you*."

Having shouldered this burden for the executive, imagine your editor's delight at discovering that our museum has "human resources", willing and able, from end to end in the editing and publishing process. All that is really necessary to produce S.P.A.R.C.'s newsletter is a bit of "prospecting" and then a bit of "mining" to find and tap those resources. From research to envelope stuffing, the first *Syntonizer* proved to be an effort of an informal, spontaneous "staff". You know who you are: from the editor and the readers, ***thanks, everybody!***

Bill's Letter

Ours is a tiny publication, its small size imposed by postal rates. One of the many sacrifices we must make is a "letters" department. This month, however, a rare exception will be made: a letter will be published. Its author has been a ham radio operator for 69 years. That alone would qualify a letter for special consideration but readers will see that this letter stands on its own merits. In the last issue of the *Syntonizer*, Bill Rieveley met an old, old friend from the 'thirties. That friend was the receiver schematic in that issue. Bill writes to tell us about that and about the B.C.A.R.A. in 1932.

This Month's Featured Area

This month's featured area of the museum is that vault at the back that contains the riches presided over by Neil. Spark and crystal detectors and the like built radio into a demonstrably viable entity but it was tubes that built those vast broadcasting empires and sophisticated long distance communications networks that were established by the middle of the last century.

This Month's Cover

Recognize that apparatus? Our cover this month shows the Museum's gate guardian tube tester. This relic from half a century ago graces the entrance to our lobby. Many of you readers, when knee high, trotted along delightedly beside Daddy as he went down to the drug store to test the tubes he'd pulled from the family's ailing five tube all American. You watched in fascination as he divined the settings for each tube and then undertook the ceremony of setting up the multitude of switches and pots.

A Coronation of King Spark at S.P.A.R.C?

Lawrence Pickup shows us this month how King Spark could regain his voice at our museum. Spark built radio communication and there is a manifestation of spark of no greater grandeur than the mighty rotary gap in full cry.

Concluded on page 7

CALL TO BUILD A SPARK GALLERY

Lawrence Pickup

What do the discovery of the electron, the neon light, the discovery of x-rays and radio have in common? In brief: the electric spark. The electric spark is so important in the history of economic progress that the building of a memorial to the spark must be high priority in all well meaning custodians of the history of radio.

No matter how strong the dielectric, at a certain voltage it will be ripped apart, no matter or force withstanding the electric force. This is spark. The impressed voltage will discharge across the gap. How much energy is so discharged is the function of the current capacity and compliance of the source of electricity. It is reported that such discharges can be the size of galaxies.

Beneath these heavenly wonders among all sorts of natural sparks like lightning and flint and tinder, Hertz, Lodge, Marconi and many others discovered and improved the radio properties of spark.

Sketchy Literature

Even those whose interest in the history of radio has led them to read something about spark transmitters rarely delve into the subject thoroughly. It is not easy. The literature is scattered and often a sketchy introduction to the vacuum tube era -"real radio." Few dare hook up a spark gap to even the shortest aerial. They fear the state regulations against interfering with "duly authorized services."

But if we look at the history of spark we will see it passed through many phases. Marconi's early sparks were totally untuned. So much that one Maskelyne, a practical joker disrupted Sir Fleming's turn of the century demonstration of radio to the Royal Society by transmitting from a nearby roof top "Mr. Marconi has taken the phenomenon of nature called wireless and patented it for his own profit." Fleming said no, on the contrary Maskelyne was a thief who should have been jailed.

"Wouldn't a working non- interfering spark transmitter of today's technology be about the best demonstration and popularization of radio history?"

We Have All The Facilities

Amusing as this story is (was this Maskelyne a relation to the Maskelyne who feuded in the 1760's with Harrison, inventor of the chronometer?) it reinforces the error that spark transmitters are untunable. In fact from that day on sparks were tuned better and better and should we not ask now - "Wouldn't a working non-interfering spark transmitter of today's technology be about the best demonstration and popularization of radio history?" why don't we make this a project? We have all the facilities. We have the priceless Marconi receiver. We have beautiful slate battery switch boards. We have professional engineers to convince the state organs for a test permit, to design the filters, transmission lines and aerials. At this juncture of cell phones and wireless internet it is a most responsible initiative for education. The hiss of the spark, the hiss of the background galactic noise.

Spark eh? Besides neon, radio, x-rays and the electron what else is spark? How about the implosion plutonium weapon, trigerred by Alvarez's krypton switch capacitor sparker. How about pulse fusion power, a really big spark. Apart from the intrinsic value of spark the publicity and hence fund raising possibilities are clear.

It would appear that the form of spark best suited to fine filtering is that of the rotary spark.

Paul Johnson has told me of some links to possible antique rotary spark sets around Vancouver.

Even if their custodians would be willing to donate them, however, they may be too fragile or too valuable to electrify.

Replica Rotary Gap

Peter R. Jensen, an Australian architect and ham, VK2AQJ also G4GZT has built a replica Marconi rotary spark transmitter as described in his book "Early Radio", Kangaroo Press. Two of Jensen's many drawings are reproduced, for the rest and for beautiful color pictures of this and his other reproductions as well as of the whole Marconi's Wireless Telegraph Company story you must buy his book or take it out of the library. His reproduction used an old fashioned looking platform with box to hold the modern automobile ignition coils.

No Need for Shielded Room

The woodwork could be done much better by looting and recombining some of the woodwork from lovely 30's radio's whose guts are gone. The DC motor is found in abundance in our society's warehouse and the brass rotor with points and pedestal are a minor machining job which the writer will happily provide if he can arouse some enthusiasm on making the whole thing work. There is no need for shielded rooms *etc. etc. etc.* if there is a negligible antenna. Spark coils are still demonstrated in schools. Arc furnaces and welding machines are ubiquitous; there is no need to worry about interference.

Curiously, as we prepare to transmit spark, history repeats itself. Ultrawide bandwidth radio, now much in the news, seeks to recreate the advantages of spark radio although under much tighter control.

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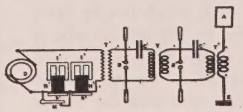


FIG. 18.—Apparatus for Multiple Transformation of Oscillations (Fleming).

with

Neil Sutcliffe
(Troll of the Tube Vault)

Tube-Testing

Eye Tubes, Concluded

Many readers may recall (if they have good memory) that I did an article on 'eye' tubes and how to boost the brightness of operable but dim 6E5 and 6U5 tubes. Instead of filling space here, those who wish to try the methods outlined and get schematics for both the filament and B+ boosters, can visit: http://antiqueradios.com/chrs/journal/eyetube.html"

Tube Testing

The subject this time is 'Tube Testing' and is one that has various camps who are vociferous as to what is 'right'. Personally, I favour the comment in most of the earlier RCA/Cunningham tube manuals that says the only REAL test for a tube is "Actual operating test in the equipment in which the tube is to be used will give the best possible indication of a tube's worth".

The two general types of test are the simple 'emission' test where the electron flow from the cathode to all other electrodes is measured. Assuming that the internal structure is intact, then as long as there are sufficient electrons available, the tube SHOULD BE good. The second common method is the 'transconductance' test, which can be static or dynamic. In this test the tube is set up in a circuit where a known bias is applied to the grid and the plate current read then the bias is changed to another known value and the plate current read again. From this data the transconductance (Gm) can be calculated. A static tester of this type generally provides a method of automatically computing the result from the settings (a crude analogue computer). The dynamic tester applies a known DC bias and AC signal to the grid, and computes and displays the Gm from the grid/plate signal ratio. Again, in these tests, assuming the structure is intact, the Gm should be good as long as there is sufficient current available from the cathode.

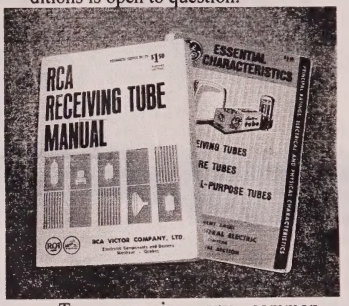
Unfortunately, in both these cases the tube is usually operating at a point far from that in the particular application it is being used in. Another, laboratory, test is the 'curve tracer' where a whole family of curves is dynamically traced on a CRT screen, and the various element biases can be set at will. With this type of tester it is possible to set up a fairly accurate model of the application (for relatively low frequencies) but the cost of such a tester is very large, and, generally, you would have difficulty interpreting the results.

Actual operating test in the equipment in which the tube is to be used will give the best possible indication of a tube's worth

These, then, are the tests for 'normal' functionality, but it is also necessary to test for abnormalities such as shorts between electrodes, gas and grid emission. Generally, both emission and transconductance testers will do a good job testing for shorts. Emission testers will not test for gas or grid emission. Transconductance testers will usually test for gas, but grid emission is often masked by low grid impedance in the tester.

It is also important to do a life test on any tube that has 'iffy' readings on either type of tester. This is simply reducing the filament voltage 5-10% and watching the reading for a significant drop. A good tube will only have a slight drop while a tube near 'end of life' will drop substantially in emission and/or Gm under this test.

A transconductance tester does allow one to match tubes at the test parameters, but whether or not it applies at the actual operating conditions is open to question.



To summarise, any common tube tester is useful to establish if a tube is faulty (open filament, low emission, shorts, opens) and no common tube tester can assure that a particular tube will operate in a given circuit. Some people advocate not testing tubes until there are indications from the circuit that it may be faulty. I feel that an initial test of the tubes, from a set that has been unused for may years, at least weeds out any clearly defective ones and reduces the likelihood of a tube being part of the problem.

For personal use, what to look for in a tube tester? CONVENIENCE! As far as brands, good makes are Heathkit, Hickok, Stark built Hickoks, Precision, Jackson and a few others. There are many testers that are awkward and time consuming to operate (non-intuitive) that should be avoided. Two good examples of this are the Precision 10-12 I recently resurrected the TV2-C/U. On first inspection the precision looks easy to use, but, in fact, has simply far too many settings that take some care to get correct, and, in the end, the results are little better than the cheap Conar in the tube room. While the TV2-C/U is very sophisticated with its many knobs and meters, it is slow to set up and not

really appropriate for routine testing.

Audio Output Tube Matching

Referring back to the tube matching on a transconductance tester, this is usually done, nowadays, for the output tubes of audio power amplifiers. This then, begs the question "what is intended to be achieved?" Given a typical output stage running in class AB_2, we want the tubes, at idle, to have equal plate currents and an idle current just sufficient to minimise the 'kink' at the crossover of conduction, but as low as possible to keep the dissipation down. Fine, but we then must have a bias control and a balance control and a method of measuring the current in each tube without disturbing the circuit in any way.

Now, lets assume that the two tubes have somewhat different dynamic transconductance over the operating area. Thus, on a positive signal swing the output will be slightly different than the output over the negative signal swing. For this there is no adjustment such as a +/- gain pot on one output tube. Fortunately, most decent amplifiers have a substantial negative feed back from the output of the output transformer to an early stage in the power amplifier, which will correct this distortion, to a large degree.

Of course this feedback will also compensate for a fairly large dynamic imbalance in the output tubes anyway, so careful matching is, in most cases not so critical. It would be far more useful to have the three controls mentioned above and adjust them dynamically for minimum intermodulation distortion and minimum harmonic distortion at, say, 10% rated power output, preferably with the feedback turned off.

Power supplies: Solid State vs Tubes

Where the original power supply in some antique equipment was equipped with tube rectifiers, should one consider replacing them with solid state rectifiers? Only with great caution!

While solid state diodes dissipate little power compared with tubes, they have several drawbacks for antique designs. First, the low forward drop in the diode results in significantly higher output voltages to the B+. Second, the abrupt turn on and turn off characteristics of the solid state diode generate large harmonic noise (hash) which can cause all kinds of noise problems in both radios and audio equipment, as well as stressing the supply transformer. As well, the low circuit impedance of a solid state rectifier can significantly increase the ripple current in the input filter capacitor, and may push it beyond its rating leading to early failure.

The nicely rounded turn on and turn off characteristics of a vacuum diode are, in actuality, a great advantage for minimising noise generation, even though it results in much higher losses. The vacuum rectifier also is, in some ways, electrically more robust than most solid state diodes, especially under transient reverse voltage situations.

In vibrator equipped car radios for example, where the gas rectifier 0Z4 has failed (a common problem), it is generally better to use a 6X5 rectifier than replace the 0Z4 with solid state diodes. These diodes are prone to fail due to the significant transients caused by the vibrator even when the snubber capacitor is in good order. On 12V car radios, the 6X5 with a 10 ohm 5 Watt resistor in series with the filament is still the best choice for the replacement of the 0Z4.

If you do replace a tube rectifier in line operated equipment with a solid state rectifier, be sure to add a resistance in series to mimic the equivalent drop of the replaced tube and also add high voltage ceramic capacitors across each diode. The capacitor value should be between 330pF and 3n3 and at least 1kV rated. In some cases a resistance of 10-33 ohms in series with each cap may also help to reduce noise.

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Bill Rieveley's Letter

Bill Rieveley,
VA3AWJ,
Rosedale Retirement Centre
Brockville, ON,
Aug 12 01

Dear John,

Thank you very much for sending the SPARC Bulletin. I enjoy it very much. I am not a good member of the group I guess and I may be behind in my dues I don't know.

I have been a ham since Feb. 1932. The person you call Bruce Mc Millan must be the son of Doc Mac Millan a member of the B.C.A.R.A. radio ham club that I was a member of in 1932. Our club house was on Fifth Avenue just east of Renfrew. Other members were King Kavalsky, Reg Town, Eric Lumley, Jack Holmes, Cecil Sawyer and others I don't remember the names of but there are a few around I think Jim Dragon and a couple of fellows in Penticton.

It seems to me that I have been moving back and forth across Canada ever since those days. The army kept moving me around. Because I had a couple of strokes, my daughters had me move back to Ontario.

My call back then was VE5CG. B.C. was the fifth district back then. The schematic diagram in page 5 is that of my first receiver only I used 2 R215 tubes I had scrounged off a U.S. battleship. My xmtr used 2 245 type tubes in TNT. The club station call was VE9AJ. I am 89 yrs old and been a ham for 69 years.

Respectfully yours
[signature] *Bill Rieveley.*

Station Break

with

Peter Trill

The Broadcast Section of the S.P.A.R.C. Vintage Radio Museum continues to be a working display as much as a visual display of a typical radio station's control room of the decades from 1950 to the early 70s. In these paragraphs, I will describe some of the operational aspects of how small stations of forty years ago put programs on the air.

The Board

The heart of the operation is the console itself which routes any of the program sources to the transmitter site. In our setup, the sources can be disc (all speeds and diameters up to 16 inches), tape (both reel-to-reel and cartridge formats), microphones and 'remotes' (programs that arrive on a pair of wires from locations away from the studio). Our *transmitter site* is only just under the desk, rather being miles away in a rural setting; our 'remotes' originate only just across the museum floor, rather than in a ballroom high atop a grand hotel.

Operation

How do all these sources get connected in the correct order and on time, so the listener hears a professional, smooth flow with no unwanted sounds or *dead* intervals? The answers lie in the prime aspects of operating -- control, cueing, and intercommunication.

'Control' of all the sources is what the console is there for. It is really a specialized audio amplifier with many inputs, each with its own on-off switch and volume control, or "pot". Audio is turned on only for the source that is on the air, ensuring that other sources don't contribute noise or inadvertent bursts of program material. The operator continually watches a meter on the console, called a VU (volume unit) meter, adjusting the relevant pot to keep the audio level from being too high (avoiding transmitter distortion), or too low (putting the program *in the noise* and losing listeners). The on-off switches may also have control contacts that can remotely start turntables or actuate relays used for microphone *on-air* lights coupled with studio monitor-speaker muting needed to prevent feedback.

'Cueing' is assuring that each program source is ready to begin nearly instantaneously on the operator's demand. For example, the third cut of an LP may be up next. The turntable is connected to a monitoring loudspeaker, the needle is set into the groove at the end of the second cut, and the platter is spun until the first notes of the desired selection are heard. Then the platter is turned backwards, giving about a third of a turn of lead-in, and the platter is put in gear with the motor off. Now the operator can start the turntable motor an instant before he wants the music, knowing that in the third of a turn, the quick-starting platter will be up to speed and pitch. The pot for the turntable is turned up just before the first sound, so the noise of the accelerating turntable platter is not heard.

For decades, listeners have taken for granted the seamless flow of music and speech reaching their radios.

Tape sources are cued in a similar way, but cartridge tapes need no cueing, because they are endless tape loops (similar to the old "eight-tracks"). These "carts" play through, then cue themselves when they get back to the beginning, by a stop tone on a separate track or, in early machines, by detection of a piece of foil on the tape surface.

To make our discussion complete, cueing of live announcers, when operating is a separate role, is accomplished by the operator's dramatic finger-point at the announcer through the studio glass window.

Intercommunication

The console is also designed for *intercommunication* to allow the operator to talk back either to announcers in an isolated studio or talk booth or to personnel at the far end of a *remote*. In the latter case, the monitor amplifier output that feeds the studio speakers is also sent down the pair of wires to the *remote*, where the program feed and operator's occasional talk-back is heard in headphones by the remote operator during moments when the remote program is not actually on the air. This is how the *far-end* of a remote stays aware of a broadcast's progress and receives cues. This *line-feed* is mandatory when the remote operator can't use a radio to listen to the live program.

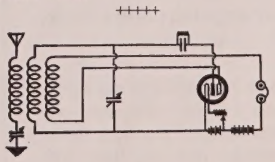
Seamless Flow

All of these processes contribute to the smooth production of traditional radio programming. For decades, listeners have taken for granted the seamless flow of music and speech reaching their radios. Broadcast techniques have been developed over eighty decades of radio. Certainly recently, computers have changed studio operations radically but the S.P.A.R.C. museum's broadcast volunteers can demonstrate the magic of the traditional operations that have been with the industry since the 1920s.

Watch How It Is Done!

Visit our operation and see (and hear!) how it all works. Put on our headphones and experience how it all sounds as you watch!

Stay tuned to Heritage radio!
Peter Trill



Editorial Comment, concluded

This month's Mini Poster

This month we honour tubes not only within the *Syntonizer* but without, too. The October mini poster shows a couple of very important participants in the story of tube electronics. Audio and radio electronics relied on these two workhorses for half a century.

The venerable 12AX7 populated uncounted audio preamplifiers and industrial devices. To this day, there are 12AX7s and their brothers, the 12AU7s, soldiering away down in filthy institutional basements operating furnace controllers.

The 6L6 and its derivatives , 12L6, 35L6, 50L6 and 117N7 were the tube of choice in power amplifiers. The tube was also used in low frequency r.f. power circuits.

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Group Museum Visits

Jack, Garry and Paul

Recently we have had a number of group visits to our museum by seniors, Lion's Clubs and similar organizations. We have even entertained a group of mentally challenged people.

The typical tour goes something like this. We show the museum in a guided fashion until the groups split up. After the members have an opportunity to wander around on their own for a while, we then bring them back together in the home radio area. Jack puts on a radio program of *Fibber McGee and Molly* or perhaps *The Jack Benny Programme*. The group members generally spend the full half hour of the program listening as people did in their living rooms fifty years ago. At the conclusion of the program, we then let them pursue their own interests among the displays with our informal guidance.

Now if you know of an organization or club that would enjoy a tour of the museum like that, let us know and we will make arrangements for them, too. Please note that we prefer to have a party of 12 to 24 people and to give the tour in the afternoon or evening. Be assured that we will provide a pleasant, low pressure visit. Because we have to pay the rent, a donation of at least $3.00 per person is requested.

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Vintage Oldies

Jack Watson

Some of the members may not be aware of the various compact discs available from the museum.

We have compilations of music of the twenties, thirties and forties compiled, presented and narrated by myself. We sell these discs for $10.00 each to members of the museum.

We also have a library of old radio shows which have been transcribed onto digital discs. These discs are loaned out to museum members.

I'm at the museum on most Sundays. Drop in and chat!

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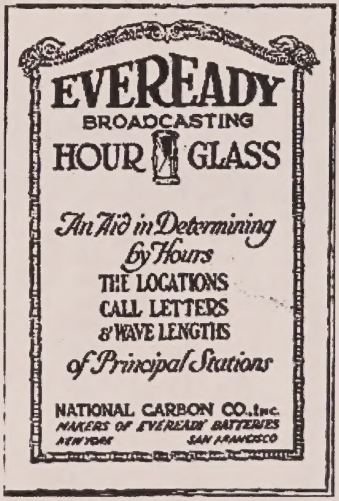
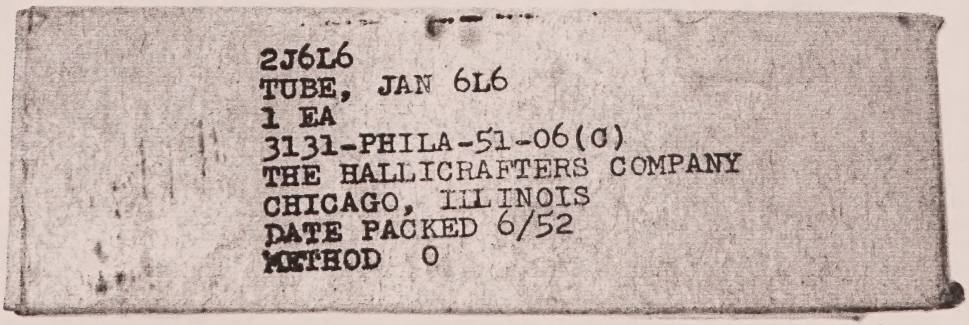
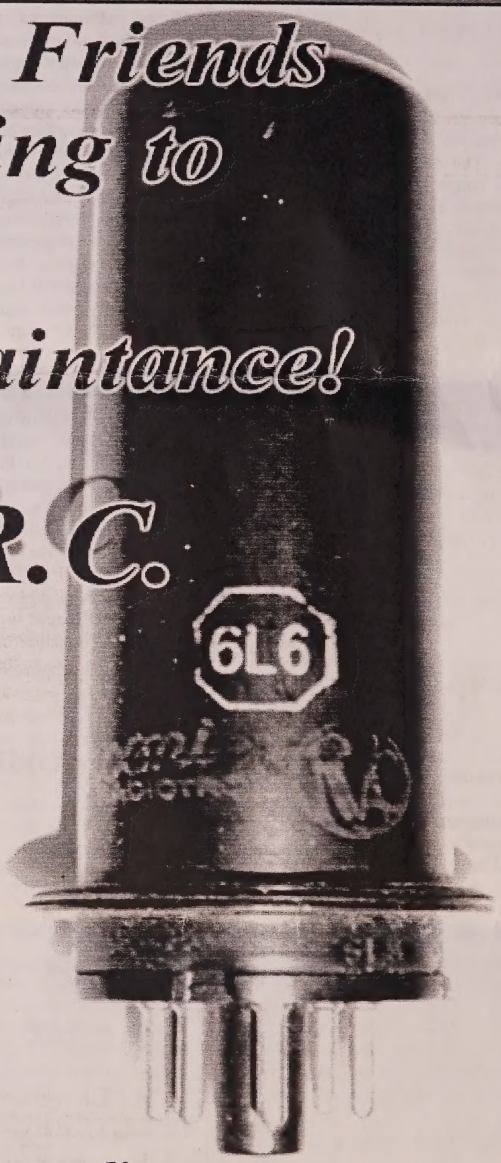




Some Old Friends Are Waiting to Renew Acquaintance!

S.P.A.R.C.



museum of antique radio

Sundays, Riverview Hospital Campus